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Report No. 94-20

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BETHESDA, MARYLAND

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Report No. 94-20 was supported by the Bureau of Naval Personnel (Pers-60) and the Naval Medical Research and Development Command, Department of the Navy, under Work Order No. N0002294WRWW549 and Research Work Unit 63706N M0095.005-6106. The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Navy, Department of Defense, or the U.S. Government. Approved for public release, distribution unlimited.

EXECUTIVE SUMMARY

Problem

Approximately 10% of Navy personnel exceed the Navy's percent body fat standards and are consequently at risk for involuntary separation from service. Although obese personnel are required to participate in the Navy's remedial conditioning program, many overweight members have been unable to reach and maintain the designated body fat standards. Recent evidence suggests that nutritional supplementation with chromium picolinate might help reduce excess body fat and increase lean muscle mass, but such findings have been inconsistent.

Objective

The present study was undertaken to explore the efficacy of chromium picolinate as a weight-reduction aid for personnel enrolled in the Navy's remedial conditioning program.

Approach

The study employed a double-blind, between-groups, placebo-controlled protocol. Participants were 95 active-duty Navy personnel (79 men, 16 women) enrolled in several command-directed remedial conditioning programs. The programs met a minimum of three times per week for at least 30 minutes of supervised aerobic exercise. Participants completed a pre-post questionnaire concerning their diet and exercise habits, mood, and sleep quality. Measures of height, weight, and percent body fat (computed from body circumference measurements and height) were obtained at baseline and again after 16 weeks. After the baseline measurement session, the sample was split into gender groups, stratified by percent body fat within each gender, and assigned alternately to either the Chromium or Placebo group. Group assignment was blind, so that neither the participants nor their program leaders knew who belonged to which group. The Chromium group received a daily capsule containing 400 micrograms chromium picolinate; the Placebo group received identical-looking capsules containing an inert calcium chloride compound. Capsules were taken every day for 16 weeks.

Results

The Chromium and Placebo groups were essentially identical on baseline measures of demographic characteristics, dietary and exercise habits, sleep patterns and mood, and percent body fat. At the end of 16 weeks, the group as a whole had lost a small though statistically significant amount of weight and body fat, but there was no significant change in lean body mass. When compared to the Placebo group, the Chromium group failed to show a significantly greater reduction in either percent body fat or body weight, or a greater increase in lean body mass.

Conclusions

Chromium picolinate was ineffective in enhancing body fat reduction in this study. There are several possible explanations for these null results: (1) Chromium supplementation was used in conjunction with an aerobic exercise program rather than with a muscle-building anaerobic regimen; (2) Participants might not have been chromium deficient, hence not responsive to compensatory nutritional supplementation; (3) Chromium picolinate is not a simple, general remedy for obesity. While the efficacy of chromium supplementation as a weight-reduction aid cannot be ruled out for some individuals, it cannot, on the basis of the present results, be recommended as an adjunct to Navy weight-loss programs in general.

Effects of Chromium Picolinate on Body Composition in a Remedial Conditioning Program

Introduction

Although it is commonly believed that body weight is determined primarily by the balance between a person's dietary intake and his or her physical activity, a number of studies provide evidence that body weight is an endogenously regulated variable (1-4). The usual body weight that a person maintains without conscious effort has been referred to as the person's "set-point" weight, which appears to have a strong genetic component. As weight deviates from this set point, physiological compensatory mechanisms begin to operate to return the individual to his or her set-point weight. This occurs in both normal-weight and obese individuals.

The degree of body weight stability that most people experience over time, plus the precision with which energy intake and expenditure must be balanced to achieve such stability, lend credence to the theory of a set point, but the nature of the proposed regulatory process is not yet understood. Weigle (2) noted that the genetic influence could be mediated primarily through a circulating satiety factor (or factors) or its receptor activity in the central nervous system; Porte and Woods (4) suggested that insulin could be such a factor. Insulin level is proportional to body fat content and also influences the hypothalamus satiety center, promoting appetite control and thermogenesis. If the metabolic action of insulin is impaired, or if tissues are insulin-resistant, the effects can range from hyperinsulinemia and hyperglycemia to hypercholesterolemia and obesity (5).

Trivalent chromium is an essential nutrient that has been implicated as a cofactor with insulin in the maintenance of normal metabolism (6). Chromium appears to help bind insulin to receptor tissues and is necessary for the proper functioning of insulin. In 1980, the recommended safe and adequate daily intake for adults of nutritional chromium was set at 50 to 200 micrograms (mcg) (7). Yet according to a recent U.S. Department of Agriculture study, most Americans probably consume less than 50 mcg/day, making chromium more likely than any other vitamin or mineral to be inadequate in the American diet (8). Low levels of chromium in the diet would be expected to produce some degree of chromium deficiency in the body (6). As chromium deficiency can, in turn, lead to insulin resistance and associated dysfunctions in carbohydrate, protein, and lipid metabolism (9), there is growing interest in the use of nutritional supplementation with chromium to prevent or ameliorate such metabolic problems.

The majority of research on the physiological role of nutritional chromium has focused on its effects on blood sugar and blood lipids, where it has been found to improve glucose tolerance and blood sugar balance in hyperglycemic subjects and significantly reduce levels of total cholesterol and low-density lipoprotein (LDL) cholesterol (6,10-12). Popular interest has centered on chromium as a "safe alternative to steroids" for athletes who hope to increase their strength and muscle mass, and, more recently, as a safe and allegedly effective aid for reducing body fat (13-15). In two studies with young men enrolled in weight-training classes at a state university,

Evans (12) found that daily supplementation with 200 mcg of chromium picolinate (one of the most biologically active forms of chromium) resulted in significant changes in body composition. In the first study, participants receiving chromium picolinate experienced a significantly greater increase in lean body mass than did those given a placebo; conversely, the placebo group showed a significant increase in percent body fat, while the chromium group did not. Results were similar in the second study: men in the chromium group showed a significantly greater increase in lean mass and a significantly larger decrease in body fat than did the men in the placebo group.

In a different study, investigators using a double-blind, cross-over design with enrollees in a weight-control clinic reported finding significant positive changes (increased muscle mass, decreased body fat) in their chromium-treated group but no significant changes in body composition in the placebo-control group (16). Although no dietary changes were prescribed for the men in the study, after 4 months, the chromium group had lost an average of 7 pounds of body fat, compared to a 1-pound loss in the placebo group.

However, other research has produced null results with respect to chromium supplementation and body fat loss. Hasten and her colleagues (17) found a significant increase in body circumference measurements and a significant decrease in skinfold measurements (suggesting increased lean mass and decreased body fat) in <u>all</u> groups--male and female, chromium picolinate and placebo--during a 12-week weight-lifting program with college-age students. The chromium groups did not demonstrate body fat losses beyond those due to the training program itself. In summarizing the findings on chromium picolinate as an ergogenic aid, Moore and Friedl (18) warned that, at present, there is no convincing evidence that chromium has a positive impact on either physical strength or body composition, but they acknowledged that more research is needed. McCarty (19) agreed that the usefulness of chromium as an adjunct to weight-loss regimens deserves attention in future studies, particularly as it might retard the loss of lean body mass that often accompanies dieting.

The present study was undertaken to explore the value of chromium for enhancing body fat loss in a military population. The U.S. Navy has established percent body fat standards for all active-duty members. Personnel who exceed the cutpoints--22% body fat for men, 30% for women--are subject to specific administrative actions, ranging from ineligibility for promotion to possible separation from the service (20). Members are measured for percent body fat biannually in conjunction with the Navy's mandatory Physical Readiness Test (PRT). Those who are out of standards are required to attend a command remedial conditioning program, which usually consists of supervised group exercise sessions conducted three or four times a week. Yet despite both punitive administrative contingencies and the mandatory physical conditioning program, many overweight Navy personnel are unable to reach and maintain the designated body fat standards (21). The reasons for this failure are not clear, but if specific nutritional supplementation could be of benefit, its inclusion as part of the remedial conditioning regimen might be appropriate and cost-effective. Therefore, the present study was conducted to evaluate the potential of chromium picolinate as a weight-reduction adjunct to the Navy's remedial conditioning programs.

Method

Overview

The study employed a double-blind, between-groups, placebo-controlled protocol. Participants were active-duty Navy personnel enrolled in several command remedial conditioning programs. The programs met a minimum of three times a week for at least 30 minutes of supervised aerobic exercise. Volunteers in the experimental group each received a daily capsule containing 400 mcg of chromium picolinate; the placebo group received identical-looking capsules containing a biologically inert calcium chloride compound. Capsules were double-assayed by the pharmaceutical supplier to ensure product quality. Dependent measures of body weight and percent body fat were obtained from the study participants at baseline and again after 16 weeks.

Sample

The Command Fitness Coordinators (CFCs) at several large Navy commands in the San Diego area were contacted by telephone to ascertain whether their remedial conditioning programs would be available for inclusion in the study during the data collection phase and, if so, the size of their enrollment. Eight command programs with a total projected enrollment of approximately 300 individuals indicated that they would be conducting remedial conditioning sessions during the data collection time frame. Formal requests were mailed to their respective commanding officers, and all eight commands agreed to participate.

The Naval Health Research Center (NHRC) research team visited each command on the first day of its remedial program to recruit volunteer participants and administer baseline measurements. A total of 175 men and 37 women agreed to participate; of these, 79 men and 16 women completed the program and remained in the 16-week study through follow-up. Reasons for attrition were varied. Some individuals were disqualified because they were already taking a chromium supplement when the study began; a number of others were dropped because they failed to pick up their capsules at the distribution point. A few individuals complained of headaches, upset stomach, or weight gain and decided to withdraw from the study (these somatic complaints were equally divided between the chromium and placebo groups). Several participants were either admitted to the Navy's inpatient obesity treatment program or were processed for administrative separation because of obesity. Two men were injured and medically excused from the remedial conditioning program. Three women became pregnant. Some participants transferred out of the area before the experiment ended and were unavailable at follow-up; others simply failed to appear at the follow-up session. Attrition rates did not differ significantly between men and women, nor between experimental and control groups. The final sample of 95 participants was composed of 51 experimental subjects and 44 controls.

Procedure

On their initial visit to the participating sites, the researchers described the purpose of the study, outlined the procedures involved, and answered questions from remedial conditioning

program enrollees. Enrollees who volunteered to participate in the research project were given a consent form to sign and proceeded with the study as described below; individuals who chose not to participate were excused from the recruiting session with no penalty and no further contact from NHRC. Participants were given a brief questionnaire concerning their medical history, health habits (including usual diet and amount of exercise), sleep patterns, and mood. The questionnaire was administered again at follow-up, minus the medical history items and with the addition of a few questions concerning compliance with the experimental procedures. Subjects were also issued daily exercise log books and asked to document the amount of time they spent each day in exercise activities, whether occurring within the context of the remedial conditioning sessions or on their own time (weekends included). There were no special dietary requirements for study participants; however, the volunteers were asked not to make any substantial changes in their eating habits once the study had begun.

Measures of height, weight, and percent body fat were obtained for all volunteers at the beginning of the conditioning program and again after 16 weeks. The same researchers performed the measurements at baseline and at follow-up, and participants were instructed to wear the same type of clothing for both measurement sessions. At the conclusion of the initial session, participants were given a sheet of instructions reiterating the study procedures and were told when and where to pick up their supply of capsules (always within one or two days, and usually at the same location as the remedial conditioning program sessions).

Capsules were prepared for distribution at the Naval Health Research Center. All subjects within a command were split by gender, stratified within gender group by percent body fat, then (beginning at the top of each gender-based list) assigned alternately to either the Chromium or Placebo group. If assignment had begun with "chromium" for one command, it began with "placebo" for the next. Participants' names and Social Security numbers were typed onto labels and affixed to their otherwise unmarked bottles of capsules, which were then delivered to the Command Fitness Coordinator for distribution. Thus, neither the individual nor the CFC knew which group the member was in, and the researchers were unable to link participants' names with the individuals themselves.

Measures

Body composition. Height and weight were measured (without shoes) using a standard physician's scale, which was calibrated and checked for accuracy at the beginning of each measurement session. Percent body fat was determined by measuring specified body circumference landmarks (neck and abdomen for men; neck, waist, and hip for women) and computing the percent fat using equations developed by Hodgdon and Beckett (22,23). Techniques for obtaining these body circumference measurements have been described in detail elsewhere (20,21). Each body landmark was measured twice, and the average of the two measurements was recorded.

Exercise. Many participants failed to turn in completed exercise log books at the end of the study; therefore, two items from the questionnaire were used instead of the logs to measure

exercise. The first item asked how often (times per week) and for how long (minutes per exercise session) the respondent engaged in aerobic exercise each week; the second item asked the same questions about anaerobic exercise. The number of minutes spent each week in each type of exercise was computed (frequency X duration), then the two scores were summed together for a total exercise score (minutes/week).

Diet. Eight questionnaire items were used to measure the participants' habitual dietary choices. Respondents were asked to indicate how many times per week they ate high-fat meats, low-fat meats (including fish), high-fat dairy products, low-fat dairy products, fruits, vegetables, whole grains/breads, and sugars/snack foods. These items were combined to form two scales, one indicating more healthful ("good") food choices, computed as the mean number of servings per week of low-fat meats and dairy products, fruits, vegetables, and whole grains, and the other indicating less desirable ("bad") selections, computed as the mean number of servings per week of high-fat meats and dairy products, sugars, and snack foods. Cronbach's alphas for the two scales were .73 and .68, respectively. A final diet score was computed as the ratio of good to bad food choices, with a higher score indicating a more healthful diet.

Mood and Sleep Quality

Schrauzer, Shrestha, and Arce (24) observed that chromium supplementation in nutritional doses might cause irritability, insomnia, increased dreaming, or nightmares in some subjects. To test this, measures of mood and sleep quality were included in the questionnaire. Participants' mood was measured using the Navy Medical Neuropsychiatric Research Unit's NPRU Mood Scale (25), which consists of a list of 29 adjectives and short phrases designated as either positive (e.g., "cheerful," "full of pep," "relaxed") or negative (e.g., "grouchy," "sluggish," "jittery"). Respondents rated themselves on each mood adjective using a 4-point Likert-type scale (0 = Not at all, 3 = Extremely). The 19 positive items were summed to form a P score, while the 10 negative items were summed to form an N score. The P and N scores are independent and are not combined in analyses.

Quality of sleep was assessed using three questionnaire items, which asked whether the respondent had experienced (a) trouble falling asleep at night, (b) difficulty staying asleep through the night, and/or (c) nightmares. The items were answered using a 3-point Likert-type scale (Rarely, Sometimes, Frequently). Sleep quality was computed as the sum of the three item responses, with a higher score indicating more sleep difficulties. A fourth item simply asked "Do you dream?," the response alternatives being the same as above (Rarely, Sometimes, Frequently).

Results

Sample Demographics

The final sample was composed of 83% men and 17% women. Mean age was 30.3 years. Average paygrade level for the group, which included only three officers, was E-5. The majority of individuals (85%) had a high school diploma, 7% had more than 12 years of schooling, and

6% had less than 12 years. Racial distribution was 76% white, 16% black, and 8% other. Two participants were discharged from the Navy because of obesity within the first year after the study had ended.

Comparisons between the 95 study completers (i.e., the final cohort) and the 109 study dropouts revealed no significant differences on sex, race, education, or number of officers. Completers were slightly older than the dropouts (30.3 years vs. 28.0 years, $p < .01$) and slightly higher in paygrade (E-5.5 vs. E-4.9, $p < .03$). When compared on baseline percent body fat, the two groups were found to be virtually identical (26.2% vs. 26.5% for completers and dropouts, respectively). Comparisons between the Chromium and Placebo groups revealed no significant differences on any of the demographic variables. Baseline percent body fat measurements (26.4% for Chromium, 25.9% for Placebo) were not significantly different.

Exercise Habits

The participants reported exercising an average of 4.5 hours per week (approximately 40 minutes per day) during the course of the study. The majority of this time (about 3 hours per week) was devoted to aerobic exercise, with the remainder being spent in anaerobic workouts. While the sample's reported exercise at baseline (5.3 hours per week) was slightly higher than that reported at follow-up (4.5 hours), the difference was not significant. When the Chromium and Placebo groups were compared on amount of exercise, no significant differences were found for aerobic, anaerobic, or total exercise time at either baseline or follow-up.

Dietary Habits

In general, the participants evidenced good dietary habits that improved during the course of the study. They scored significantly higher on the "good" diet scale than on the "bad" diet scale at both baseline ($t = 3.78$, $p < .001$) and follow-up ($t = 6.10$, $p < .001$). Moreover, their bad diet score decreased significantly between the two time periods ($t = 3.11$, $p < .01$). The Chromium and Placebo groups did not differ in their dietary habits (good diet, bad diet, or good/bad ratio scores) at either baseline or follow-up.

Almost one third of the volunteers reported taking vitamins or health food supplements on a regular basis; such usage occurred about equally within the Chromium and Placebo groups. Twelve participants reported following a special diet program or restricted caloric intake during the study, but again, there was no significant difference between the two groups on this variable.

Sleep Patterns and Mood

The possible range of scores on the sleep difficulties scale was 3 to 9 points. Mean score for the participants was 3.9 at baseline, 3.7 at follow-up, indicating very few sleep problems at either time. The observed decrease in problems approached but did not reach significance ($p < .07$). There was no significant difference in sleep difficulties between the Chromium and Placebo groups at either baseline or follow-up.

During the course of the study, there was a small but statistically significant improvement in subjects' mood scores. The P score (positive mood) increased from a mean of 35.0 at baseline to 37.4 at follow-up ($t = 2.27$, $p < .03$), while the N score (negative mood) decreased from a mean of 9.0 to 7.8 ($t = 2.51$, $p < .01$). The P score was correlated positively with aerobic (but not anaerobic) exercise ($r = .28$, $p < .01$) and negatively with sleep difficulties ($r = -.23$, $p < .05$); the N score also correlated with sleep difficulties ($r = .30$, $p < .01$) but not with exercise. The Chromium and Placebo groups did not differ significantly on any mood scores at either baseline or follow-up.

Body Composition

Comparisons between baseline and follow-up anthropometric measurements revealed that the participants succeeded in losing weight, but very little. The group as a whole lost an average of 0.6% body fat (26.2% vs. 25.6%, $t = 2.69$, $p < .01$) and 2.7 pounds (197.7 vs. 195.0, $t = 2.79$, $p < .01$) over the course of the 16-week study; there was no significant change in lean body mass. When results for men and women were examined separately, it was found that the men (83% of the sample) followed the same pattern as the entire group, but none of the women's measurement scores had changed significantly at follow-up. In terms of the Navy's body fat standards (which allow a maximum of 22% body fat for men, 30% for women), 75% of the men and 81% of the women in the sample exceeded the standards at baseline. At the conclusion of the study, 68% of the men and 81% of the women remained above standards.

Table 1 presents mean baseline, follow-up, and difference (Δ) scores for percent body fat, body weight, and lean body mass for men and women in the Chromium and Placebo groups. Analyses of covariance were conducted to evaluate differences in results between the Chromium and Placebo groups. Dependent measures were the three difference scores (change in percent body fat, change in body weight, and change in lean body mass between baseline and follow-up), with exercise (total minutes per week) and diet (good diet/bad diet ratio) covaried. No significant differences were found on any measure. A total of 62 participants had lost body fat during the experiment: 32 were in the Chromium group, 30 in the Placebo group. Thirty-one individuals had gained body fat: 17 had received chromium, 14 had received the placebo. Two volunteers showed no change after 16 weeks: both were in the Chromium group.

It is possible that lack of compliance with the experimental regimen introduced bias and confounded the results. To explore this possibility, the data were examined in conjunction with information obtained from the follow-up questionnaire. Compliance items on the questionnaire (e.g., "Did you remember to take your capsules during the study?") indicated that some participants frequently forgot to take their daily capsules, while several others had missed taking their supplements for an entire week or more at some point during the study. There were, however, no differences between the Chromium and Placebo groups in their responses to these items, and when poor compliers were removed from the analyses in post-hoc tests, results were the same as reported above.

TABLE I.—*Changes in percent body fat, weight, and lean body mass between baseline and follow-up (16 weeks), by sex and group (Chromium/Placebo).*

		Percent Body Fat (%)		
		Chromium	Placebo	Total
Men	Baseline	24.7	24.3	24.5
	Follow-up	24.4	23.2	23.8
	Δ	-0.3	-1.1	-0.7
Women	Baseline	34.4	34.6	34.5
	Follow-up	33.8	34.8	34.2
	Δ	-0.6	+0.2	-0.3
Overall	Baseline	26.4	25.9	26.2
	Follow-up	26.0	25.0	25.6
	Δ	-0.4	-0.9	-0.6
		Weight (pounds)		
		Chromium	Placebo	Total
Men	Baseline	205.4	205.2	205.3
	Follow-up	203.6	201.5	202.7
	Δ	-1.8	-3.7	-2.6
Women	Baseline	161.1	158.9	160.1
	Follow-up	157.3	158.6	157.9
	Δ	-3.8	-0.3	-2.2
Overall	Baseline	197.6	197.9	197.7
	Follow-up	195.5	194.5	195.0
	Δ	-2.1	-3.4	-2.7
		Lean Body Mass (pounds)		
		Chromium	Placebo	Total
Men	Baseline	153.5	154.1	153.7
	Follow-up	152.8	153.8	153.3
	Δ	-0.7	-0.3	-0.4
Women	Baseline	105.1	103.6	104.5
	Follow-up	103.6	103.3	103.5
	Δ	-1.5	-0.3	-1.0
Overall	Baseline	144.9	146.0	145.4
	Follow-up	144.1	145.6	144.8
	Δ	-0.8	-0.4	-0.6

Of greater concern was the fact that chromium supplements are available over-the-counter in drugstores, health food stores, and Navy commissaries. Although the participants had been enjoined from taking their own chromium supplements during the experiment, eight individuals reported on the follow-up questionnaire that they did use such supplements at some point during the study. When these eight participants (six of whom were in the Chromium group) were eliminated from post-hoc analyses, results remained unchanged.

Discussion

Chromium picolinate supplementation, used in conjunction with an aerobic exercise program, was ineffective in enhancing body fat reduction in this study. The Chromium group failed to show a significantly greater reduction in either percent body fat or body weight, or a greater increase in lean body mass, when compared to a placebo control group. We think that both the dosage used and the duration of the trial were sufficient to permit observation of the hypothesized effect. Typically, the supplemental dosage used in chromium research is 200 mcg/day. Although some studies have reported significant changes in body composition at that dosage level, it has been suggested that a higher dosage might be more effective, particularly for men (16,17,26). This study employed a supplemental dosage of 400 mcg/day but failed to show an effect. Positive effects have been observed in as little as 14 days (11), though Lefavi and his colleagues (27) argued that such rapid results are inconsistent with the anabolic processes associated with enhanced insulin function, and that anthropometric changes issuing from chromium supplementation would be expected to take a longer period of time, "perhaps many months." The present study was conducted for a period of 4 months--considerably longer than most previous research--yet no significant between-group differences were found.

Fisher (5) emphasized that chromium supplementation should be combined with resistance training to accelerate muscle development and concomitant fat loss. Indeed, if chromium potentiates insulin's anabolic effects on muscle protein synthesis, those effects logically would be enhanced by a muscle-building training program. A possible explanation for chromium's lack of efficacy in the present study, therefore, might be that it was used in conjunction with an aerobic exercise program rather than the anaerobic regimen employed in some of the literature's more notable results. In both of the placebo-controlled studies reported by Evans (12), 200 mcg/day chromium picolinate supplemention resulted in significant losses in body fat and increases in lean body mass after just 6 weeks. The volunteers in both studies were young men enrolled in a weight-training class. On the other hand, Clancy and coworkers (28) found that 200 mcg/day chromium picolinate was ineffective after 9 weeks in producing changes in either body composition or strength among young men in a weight-lifting program, suggesting that something more or other than type of exercise activity is responsible for the null results in the present study.

Another explanation might be that the participants were not chromium-deficient. As Anderson and his collaborators (10) have pointed out, chromium is a nutrient, not a drug, at least not at the dosages typically used. Since the function of a nutritional supplement is to compensate a deficiency, no benefit would be expected among subjects with adequate chromium stores.

Unfortunately, no simple, reliable test is available for determining chromium deficiency (9). Analysis of the balance between daily chromium intake and urinary chromium excretion would have provided an indicator of chromium status, but such analysis was beyond the scope of this study.

The most parsimonious explanation for our null results is that chromium, though necessary for normal metabolic functioning, is not a quick cure for obesity, and perhaps not a remedy at all. This should not come as a surprise. Regardless of whether it is mild or severe, obesity is proving to be a chronic, multidimensional, difficult-to-manage condition requiring a comprehensive approach to treatment and posttreatment maintenance (29). It is of note that in the present study, the overall changes in weight and body fat were minimal, even among this physically active and presumably motivated group of participants. At the end of 16 weeks, the group as a whole had only lost an average of 2.7 pounds and 0.6% body fat. The recommended goal for people who are attempting to lose weight is about 2 pounds and 0.5% body fat *per week*.

These results appear to lend support to the set-point theory of body weight, but they do not uphold the hypothesized link between body fat, insulin insensitivity, and chromium. If chromium-escorted insulin does play a role in stabilizing body weight at a particular level, the regulatory processes involved are likely to be varied and complex. Among overweight individuals with an underlying metabolic problem such as insulin insensitivity, chromium supplementation might be helpful in reducing body fat. But it is doubtful that all instances of obesity involve metabolic dysfunctions, or that all metabolic disturbances are insulin-related, let alone chromium-related, or even that all instances of insulin insensitivity borne of chromium deficiency are equally culpable in the etiology of obesity.

One might argue that chromium supplementation, though still unproven, warrants a more open-minded and receptive attitude. There is, after all, evidence that most Americans do not obtain the recommended 50 to 200 mcg/day of chromium in their diets (8). Moreover, because physical exercise increases the excretion of chromium, athletes and other physically active people are probably at increased risk for chromium deficiency (27,30). Given the combination of dietary restriction and physical exercise common among people who are trying to lose weight, supplementation with nutritional chromium would seem a prudent measure to ensure adequate nutrition, if not to enhance weight loss.

A word of caution is in order, however. Scattered anecdotal and case-history accounts suggest that chromium supplementation could possibly have adverse effects in certain individuals. Schrauzer et al. (24) cited reports of headaches, sleep disturbances, and negative mood changes; Huzonek (31) described changes in cognitive, motor, and perceptual processes; Lefavi et al. (27) questioned the safety of picolinic acid and noted that chromium may compete with iron at serum protein sites. Trivalent chromium salts are generally regarded to have very low toxicity (24,26,32), and there was no evidence in the present study of any untoward somatopsychological effects due to chromium ingestion. Further research is needed on individual differences in both the need for, and sensitivity to, this newly popular trace element.

In summary, this study failed to support the efficacy of chromium picolinate for enhancing body fat loss in conjunction with an aerobic exercise program. Thus, while the efficacy of chromium supplementation as a weight-reduction aid cannot be ruled out for some individuals, it cannot, on the basis of the present results, be recommended as an adjunct to Navy weight-loss programs in general.

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Acknowledgements

The authors would like to thank Jeff Korber and Nutrition 21 for their support of this research. We would also like to thank LT Mark Bourne, MSC, USNR, and LCDR Larry Shaw, DC, USN, for their assistance in collecting the data.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE
06 Dec 94

3. REPORT TYPE AND DATE COVERED
Interim

4. TITLE AND SUBTITLE
Effects of Chromium Picolinate on Body Composition in a Remedial Conditioning Program

5. FUNDING NUMBERS
Program Element: 63706N
Work Unit Number:
M0095.005-6106

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Health Research Center
P. O. Box 85122
San Diego, CA 92186-5122

8. PERFORMING ORGANIZATION
Report No. 94-20

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Naval Medical Research and Development Command
National Naval Medical Center
Building 1, Tower 2
Bethesda, MD 20889-5044

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

Recent evidence suggests that nutritional supplementation with chromium picolinate might help reduce excess body fat and increase lean muscle mass. This study explored the efficacy of chromium picolinate as a weight-reduction aid for obese personnel enrolled in the Navy's mandatory remedial conditioning program (Level I). Participants were 95 active-duty Navy members (79 men, 16 women) enrolled in several remedial programs, which met a minimum of three times per week for at least 30 minutes of aerobic exercise. The study employed a double-blind, placebo-controlled protocol. Percent body fat was computed from body circumference measurements obtained at baseline and again after 16 weeks. Participants also completed a pre-post questionnaire concerning their lifestyle habits. Half of the participants received a daily capsule containing 400 micrograms of chromium picolinate; the other half received a placebo. At the end of 16 weeks, the group as a whole had lost a small amount of weight and body fat; however, the Chromium group failed to show a significantly greater reduction in either percent body fat or body weight, or a greater increase in lean body mass, than did the Placebo group. It was concluded that chromium picolinate was ineffective in enhancing body fat reduction in this group.

14. SUBJECT TERMS
Chromium picolinate, Trace minerals, Athletes, Exercise, Sports nutrition, Weight management, Obesity, Navy standards

15. NUMBER OF PAGES
18

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited